# CITRUS

## Vol. II.

**Sri. SHANKER PILE,**
**(Retired Horticulturist)**
**Department of Agriculture, Hyderabad.**

Published by:
**HYDERABAD FARMERS' UNION,**
HYDERABAD-DN.
**1956.**

ANNAS 8

Printed at:
CITIZEN PRESS,
Secunderabad.

## CONTENTS


| | Page |
|---|---|
| The Plantation ... ... ... ... | 1 |
| When to Plant Citrus Trees ... ... ... | 3 |
| Irrigation ... ... ... ... ... | 5 |
| Manuring ... ... ... ... ... | 9 |
| Formulae Quantities of Manure Required ... | 13 |
| Time & Method of Manuring ... ... | 17 |
| Prunning ... ... ... ... ... | 19 |
| Harvesting ... ... ... ... | 27 |
| Grading ... ... ... ... ... | 29 |
| Packing ... ... ... ... ... | 29 |
| Marketing of Fruits ... ... ... | 30 |
| Yields ... ... ... ... ... | 30 |

# CITRUS

## Vol. II.

## THE PLANTATION

Before the planting is actually commenced, the varieties most suitable to the locality should be carefully chosen.

**Selection of Varieties:**

Generally speaking citrus varieties have a wide range of adaptability with regard to their climatic and soil requirements. But all varieties do not thrive equally well in the same place. Therefore varieties for planting in any locality under a particular set of conditions have to be selected strictly with reference to these conditions. We find that in Punjab the malta varieties, in Madhya Pradesh the Santras, in Bombay and Deccan the Mosambi in the Andhra tract the Batavian or Sathgudi or Chini are grown in preference to others.

Another matter that the grower has to decide is the number of each citrus group that he should plant. Usualy citrus orchards contain a mixture of santras, mosambies, pummeloes and sour limes with a few trees of lemons thrown in.

**Selection of Plants:**

To get the best results the best stock has to be chosen. The plant should be of uniformly high quality and of the proper age. It should always be kept in mind that the best that can be secured is the cheapest in the long run and poor stock remains poor throughout its life and is therefore dear at any price. No effort should be considered too much and price should not be the

criterian in securing only first class ones. An ideal citrus plant is one that has the folowing features:

1. It must have the characteristics of the variety and it need not be one that grows straight and smooth, tall or stocky;
2. It should be of medium size and of one or two seasons growth;
3. In budded trees the union must be neither far above nor too near the ground when planted;
4. It should be free from diseases and pests;
5. It should not be stunted in growth, nor on the other hand, show signs of having been unduly forced to bring it up to size. This is indicated by sappy angular growth and long inter nodes. It must be an offspring from a known parent of outstanding quality.

No two trees in any orchard are alike either in their yield or in their vigour and habit of growth. Some trees bear heavy crops every year and some do not. Scion buds always tend to reproduce the permanent characteristics of the parent trees from which they are taken.

The nursery trade in India is still mostly in the hands of people who are not conversant with the scientific aspects of plant propagation and fruit culture. Plants are propagated with the sole object of selling them, without any consideration for their quality or standard and their ultimate behaviour and performance during orchard life. It is, therefore, advisable for growers to propagate their requirements under their own personnal supervision and care, or purchase from nurseries run or sponsored by Government Institutions. The risk of getting unreliable and unsuitable plants is less, though the cost, etc. may be more.

It is never a good plan to mix first and second class trees together in orchard planting. It is neither advisable

nor economical because except for the initial cost the cost of rearing is the same while the difference in yield is always very great.

**When to Plant Citrus Trees:**

The best time for planting citrus is rainy season. During the summer months transplanting of citrus plants is a difficult operation and it is better not to attempt it. In the Deccan, South India, any time between the months of July and December is ideal. Transplanting should always be done in the evenings so as to enable the plant to start establishing itself in the new situation during the following cool hours of the night rather than in the morning.

**Spacing:**

There is considerable difference of opinion regarding the planting distance for citrus trees and probably this is not without reason. The proper distance for planting depends upon soil, climate, and root stock.

The following spacing may be regarded as approximately suitable for budded stock:—

| | | |
|---|---|---|
| 1. | Tight skinned oranges | 22 to 33′ |
| 2. | Loose skinned oranges | 18 to 24′ |
| 3. | Lemons | 15 to 20′ |
| 4. | Sour Limes | 15 to 20′ |
| 5. | Kumquats | 12 to 15′ |
| 6. | Pummeloes | 15 to 20′ |
| 7. | Grape fruit. | 20 to 25′ |

Seedling plants of all of the above varieties will want an increased spacing by about 5 feet both for the minimum and the maximum distance as given for budded plants above. The maximum spread of the variety of

citrus under the local conditions will determine the distance at which they should be planted.

**Preparation for Planting:**

When the field is ready for planting pits 3′ square and as much deep are dug, except in silty soils. It is convenient to get the pits ready during the hot weather for planting with the advent of rains. While digging pits care should be taken to heap the upper half and the lower half of the soil separately. While filling in the soil from the upper half of the pit goes into it first followed by the lower half. Fill the pit mixing with following manures:

| | |
|---|---|
| Bone meal | 5 pounds |
| Oil cake | 5 pounds |
| Cattle manure | 10 baskets. |

The use of a planting board is necessary after filling the pit. Citrus trees are planted with naked roots or with a ball of earth round the root. In either case parts of the root must have been left in the soil while digging them up, and the parts left attached to the trees must have been injured. With trees with a ball of earth, exposed root parts may be trimmed off before setting in the pit. It is also the usual practice to remove all the leaves and most of branches immediately before planting. Some branches are removed with the object of giving the tree a straight smooth stem and a good shape. The presence of a few leaves helps the tree to start into fresh growth quicker.

**Care After Planting:**

The plant is placed in the centre of the pit in a hole made sufficiently large to receive it and the hole filled in with earth which is pressed round with the planters' feet. Plant should never be planted deeper than they stood in the nursery. The budded portion should be well above ground level. If the bud joint is buried, the buried stem is exposed to the attack by white ants and the bud

joint to attack by a disease known as gummosis. This disease also gives trouble if the bud joint is within the reach of irrigation water.

After planting, the young plants have to be supported by a stake in windy tracts and protected from the sun to prevent sun burn. Hundreds of trees are either completely destroyed or very seriously damaged for want of this simple protection. It is easy to provide this protection by covering the trunk with red ochre or white wash, or by wrapping the exposed trunk with grass, or plantain leaf sheaths and some other suitable material.

To complete the planting operation, the planted trees should be properly labelled. If several varieties are planted, it is always very useful to have a plan of the plantation showing the position of each tree and its name. To prevent damage by wind a fast growing hedge like Sesbania can be raised to afford temporary protection to the young plantation till the regular wind break is established. Immediately after the plants are planted they should be watered well.

**Irrigation:**

Citrus trees are more or less active all throughout the year and unless the water supply is adequate and assured, it is useless to attempt the growing of citrus trees. Water requirements depend on several factors. They are:—The depth of the soil, age, and bearing capacity of the trees, the kind of stock, prevailing winds, sun shine, temperature and atmospheric humidity.

After the first irrigation, lighter one is given 4 to 5 days after. Later irrigations are given at regular intervals. Light soils require more frequent waterings than heavy soils. Irrigation once a week in summer, every ten days in the cold season and if necessary during breaks in rainy season is about the optimum.

In heavy soils citrus roots are found in the top 2′ to 3′, in light soils the depth is more. Therefore, irrigation

should confine itself to wetting this root zones as frequently as will be required to keep them from drying out. It is a common practice among growers to irrigate citrus orchards heavily and indiscriminately. Excess of water can be as injurious as scarcity of it. A rough test to find out when the orchard is in need of water is to take a handful of soil from about 6 inches under the surface and crush it in the hand. If the soil forms a lump, no water is necessary still, if however the soil crumbles into powder the necessity for irrigation is indicated.

Water for citrus trees should be sweet. It should be free from alkali of any sort; otherwise trees begin to suffer from accummulation of harmful salt in the soil and it is often very difficult to remove such accumulation.

**System of Irrigation:**

**Chain System:**—The most important methods of irrigating citrus orchards are the chain, basin, improved basin, ring, furrow and flooding. In young orchards this system where a water channel is run along the line of the planted trees is in general practice. Sometimes small basins are made round each tree to enable more water to be held in. While this system allows plenty of room for the cultivation of inter crops in between the rows of trees, it is defective as the distribution of water is not even, the trees at the end of the row getting very much less water than the tree at the head. When however the trees grow up and a larger surface of land has to be watered to enable water to reach the spreading roots this system has to give place to other methods, the basin method being in general practice in India.

**Basin System:**—Small basins are made round each tree circular or square in form and water is run into these basins through a sub-channel running along the sides of the rows of trees, during the early years of the plantation. This sub-channel is shifted towards the middle of the rows little by little till ultimately, by the time the trees begin to bear, the channel is placed in the mid-

dle of the rows and water is delivered to the trees by means of subsidiary channels. As however the interior of the basin is ordinarily flat, the tree trunks come into contact with the irrigation water during the time it takes the water to soak into the soil. Some growers try to overcome this, by heaping earth immediately round the trunk of the tree so as to prevent irrigation water from coming directly into contact with the trunk. In light and medium types of soil this works fairly satisfactorily but in cases where plantations stand on heavy soil, the heap of clay immediately round the trunk damages the bark and if allowed to remain for a long time the trunk is girdled, leading to the total destruction of the plant. To prevent the possibility of such a calamity, a modified basin method called the ringed basin is brought into use. In this method a circular bund 6 to 9″ in height is formed round the tree trunk and a little removed from it. This also has its own defect. They are often broken through by the force of the water running into the basin and the ring gets flooded. Another modification of the basin method known as the sloping basin has been found in practice to meet all the demands of satisfactory irrigation. The interior area of the basin instead of being in one flat level, is made to slope gradually from the trunk to the periphery of the basin. When irrigation water is let in, it fills in at the periphery first and remains there longer than towards the trunk. If the interior of the basin all along the boundary is made about 6 inches lower than the level of the soil at the trunk, water need not touch the trunk at all and even if it does touch, it will be only for a very short time and the danger of the trunk getting affected is eliminated. Under conditions where the land is not absolutely level, the basin method of irrigation is the best for the following reasons:

1. Small basins are sufficient for young trees and water is not unduly wasted;

2. In cases where brackish water is the only source of irrigation water, this system is useful in that

it gives deeper penetration than any other system and enables to wash down the harmful salts down below the root zone;

3. It is more economical than other systems for, in regions where water is scarce irrigation is possible with a limited quantity of water.

4. More space is available for inter crops;

5. There is less loss by evaporation on account of basins being shaded by the trees above;

6. Cracking of soil is prevented for, it is easily possible to keep the basins easily mulched;

7. It is the only practical method when the orchard stands on irrigation slopes. In its ultimate form the whole of the orchard area is thrown into rectangles or squares enclosing the trees, with water channels running along the middle of the tree rows. It is similar to the method of irrigation called the "chek method".

**Furrow Method:**

This method except in some parts of North India is not in general practice and cannot be recommended until after sufficient trials are made. Outside India, however, this is the method in general use in most of the citrus growing tracts. In this system a number of furrows are made in the intervening spaces between the tree rows, the number varying with the age and size of the trees. In irrigating orchards with small trees fewer furrows are made than in orchards growing larger trees. The water is not turned into all the furrows at one time but is supplied to a small number only. The water is allowed to flow gradually and sink into the soil well. After irrigation, the soil is tilled as soon as its condition permits. This method is recommended for medium and heavy soils. It is said to have the following merits:—

1. Better results are obtained with the same amount of water;

2. It prevents over-saturation and inter-cultivation is possible without having to wait for the soil to get dry;

3. Loss from evaporation is less as the area covered by the water is less than in the check or flood system;

4. It effects even and deep distribution. It has disadvantages also and these are:—

a. The flow of water has to be so regulated as to control its gradual seepage into the sides and bottom of the furrow;

b. In heavy soils continued application of water at the same depth frequently brings about the formation of a hard pan and prevents water from entering into the soil.

**Flood Irrigation:**

The flood method consists of applying water over the whole of the land. This necessiates an abundant supply of water and level ground. In the early years when the trees are young and the roots only occupy a part of the land, this method causes much waste. It encourages rank weed growth and consequently greatly increases the cost of weeding.

**Manuring:**

Judicious manuring of citrus orchards is of importance. Our present knowledge however regarding the actual requirement under the diverse conditions obtaining in India is meagre. Different varieties have different requirements and there is considerable variation in the manurial needs of different soils. There appears to be general agreement among citrus growers that nitrogenous manures are essential in the early stages of growth to

build up a good root system and promote vigorous vegetative growth. For bearing trees, a proper balance between vegetative and fruit production has to be secured and therefore all the important plant food elements have to be supplied in suitable proportions. Potash manures play an important part in the formation of starch, sugar, fruit and the woody parts of the trees. An adequate supply of potash has a pronounced influence on the keeping quality of citrus fruits. It also forms firm wood which makes it resistant to cold, insect attacks and fungoid diseases.

Phosphoric acid stimulates fruitfulness, promotes the formation of flowers and seeds, and hastens the process of ripening. It has a beneficial effect in encouraging the development of root growth in young plants. If plants show a tendency to be sappy an application of a phosphatic manure corrects this tendency and restores the balance.

Fertilizers containing all the three elements are termed complete fertilizers. As farmyard manure contains all these elements it is a complete manure and citrus trees in India, are grown with only this manure and the results obtained are satisfactory.

Besides Nitrogen, Potash and Phosphoric acid, plants require a number of other elements which are considered essential for plant growth. Some of these are derived from the soil such as calcium, iron, sulphur, zinc, magnesium, manganese, boron, copper etc. Most of these essential elements are present in the soil and the grower need not regularly provide these to the plant. Sometimes some of these have to be applied to the soil to supplement the supply already present. The lack of these elements in the soil inadequate quantities bring about physiological diseases in the plants. The important functions of a few minerals are enumerated below.

**Nitrogen:**

Lack of nitrogen results in sparse foliage, poor growth and yellowish leaves, yield gets reduced. This

condition is corrected by the addition of Ammonium sulphate.

Excess of nitrogen on the other hand, promotes undue vegetative growth at the expense of fruiting, ripening gets delayed, leaves drop and roots may burn. In the absence of good aeration this condition is greatly aggravated. Two pounds of nitrogen per tree is about the maximum that should be applied to each tree. Some growers apply not more than one.

**Phosphorous:**

Want of phosphorus is associated with leaf burn, and leaf shedding coarse fruit, and thick peel. Addition of ample quantities of organic matter will make the material available to the plant and controls the diseases. Excess of phosphorous aggravates zinc deficiency.

**Potassium:**

Shoots get twisted and leaves crinkled or cupped, they get scorched on one side but do not drop off. Application of potash fertilisers or cattle manure corrects this disease. Excess of Potassium reduces yield and the margins of leaves get whitish.

**Calcium:**

This occurs only in regions of heavy rainfall. Leaf tips and margins become yellowish, grow inwards shoots die back and trees get stunted. Addition of lime or some calcium fertilizer is indicated under the above conditions. When calcium is in excess, the soil becomes alkaline causing deficiency of iron, zinc, copper and manganese.

**Iron:**

Growth ceases, new leaves become small. Some leaves may get white and drop off. In several cases the leaves excepting the middle but including the veins become yellowish. Spraying or injecting iron sulphate brings temporary relief. Since the availability of iron is decreased

in alkaline soils, acidic fertilisers should be preferred. Excess of watering and phosphates aggravate the iron deficiency while ample organic matter in the soil will be beneficial.

**Magnesium:**

Unlike in calcium deficiency the yellowing of leaves develop from the middle outwards. Mature leaves become bronzed. The symptoms are more in heavy fruiting trees near the fruit maturing stage.

Regular application of magnesium sulphate is recommended at the rate of two to four per cent of magnesium oxide in the annual fertilizer mixture.

**Boron:**

Deficiency of this causes splitting and corking of the tendrils and veins of the leaf and also curling downwards. Leaves also may be enlarged and become thick lustreless and bronzed and may drop off. Back of shoots may also split as in prolonged nitrogen and iron deficiency or excess or deficiency of potassium. Hard misshapen fruits also occur. Gum may form in the fruit which may be small and less juicy. As against the gums on the outside of the peel and in segments, the boron deficiency is inside the peel and in the core.

Boron is more soluble in acid than in alkaline solutions. Excess is poisonous to plant, causing burning of tips and leaf margins with gum spots on the underside of the leaf which falls off. Excess of boron is corrected by making the soil acidic and leaching it off when soluble. Irrigation water is occassionally the source of boron excess.

**Sulphur:**

Leaves get small and uniformly yellow, it also causes week bloom, die back in weak shoots and small misshapen fruit with thick peel and shrivelled juice sacs and granulated pulp. When sulphate is added trees recover quickly.

**Manganese:**

Chlorosis of new growth with resinous excretions result. Young leaves show a net work of green veins though not as distinctly as in iron deficiency. Leaves are not reduced as in zinc deficiency. Fruits do not show any symptoms.

**Zinc:**

Most wide spread disease causing typical yellowing of leaf excepting of veins and midribs, multiple buds are formed and yields and fruit quality are lowered. Young shoots may die back. Control is effected by spraying zinc sulphate lime mixture (5-5-50) regularly.

**Copper:**

Causes die back. Large dark green leaves are formed in soft long angular shoots and these bend downwards, terminal leaves are irregular in shape and often split. Bordeaux mixture spray is curative.

**Formulae — Quantities of Manure Required:**

As it is not possible to give any definite advice regarding the manurial treatment to be given to growers of different varieties and under various climatic and soil conditions it would be perhaps better, for a grower to try a few combinations of manures in their own orchards and find out for himself the formulae that gives the best results. Obviously it will take him some years to arrive at desirable results but it will be useful ever afterwards.

The following formulae for manuring citrus orchards have been compiled from the available Indian literature and it is expected that these will help growers in finding out the best treatment to meet their local conditions and the requirement of the particular varieties they desire to grow commercially.

1. 2,000 pounds of cattle manure or compost and 34 pounds of groundnut cake per full grown tree per year (Naik).

2. Ammonium sulphate 5 lbs. per tree after Green manuring (Naik).

3. Ammonium sulphate 1 part, Muriate of potash 2 parts, Super phosphate 4 parts.

   ½ lb. each for young trees.

   1 lb. each for trees 12 to 18 months old.

   2 lbs. each for trees 4 years old.

   3 lbs. each for trees 7 to 8 years old.

   The orchard to be green manured each year. (Naik).

4. Groundnut cake 12 pounds, Fish manure 9 pounds, Bone meal 3 pounds and Cattle manure 60 pounds.
   For each full grown tree.

5. Sulphate of Ammonia 1 part, Super phosphate 1 to 4 parts and Sulphate of potash 1 part.
   The above mixture to be applied at the following rate.

   ¾ pound for a one year old plant. The quantity is increased till the mixture is the proportion of 4 to 5 pounds of sulphate of ammonia. 5 to 10 pounds of super phosphate and 4 to 5 pounds of sulphate of potash per tree when the trees are 10 years old. There after the quantities and proportions of the mixture per tree are kept constant.

| | 1st year lbs. | 2nd year lbs. | 3rd year lbs. | 4th year lbs. | 5th year lbs. | 6th year lbs. | onwards per tree. |
|---|---|---|---|---|---|---|---|
| Cattle Manure | 20 | 40 | 60 | 80 | 100 | — | 120 |
| Ash | 3 | 6 | 9 | 12 | 15 | — | 15 |
| Bone meal | 1 | 2 | 3 | 4 | 5 | — | 5 |
| Oil cake | 2 | 4 | 6 | 8 | 10 | — | 5 (Naik) |

7. Sulphate of Ammonia 6 cwts. Super phosphate 3 cwts., Sulphate of Potash 1½ cwts.
   *Dose:* 1st year 1 lb. per tree, 2nd year 2 lbs. per tree, 3rd year 3 lbs. per tree, 4th year 4 lbs. per tree, 5th year 5 lbs. per tree, 6th year 6 lbs. per tree, 7th year 7 lbs. per tree and so on

(commercial fruits of India)

8. Super phosphate 30 pounds, Potassium Sulphate 16 pounds, Cake 44 pounds and Ammonium sulphate 10 pounds.

   The above mixture to be applied as follows per tree:— ......

   Trees 1 to 2 years old 3 pounds. Trees 2 to 3 years old 4½ pounds. Trees 3 to 4 years old 5½ pounds. Trees 4 to 5 years old 6 to 8 pounds. Trees 5 to 6 years old 9 to 10 pounds.

There after bearing trees should receive the following mixtures:—

40 pounds of super phosphate, 20 pounds of potassium sulphate, 30 pounds of cake and 10 pounds of ammonium sulphate as follows:

6th year 10 pounds. 7th year 12 pounds. 8th year 14 pounds. 9th year 16 pounds. 10th year 18 pounds. 11th year 20 pounds.

After the eleventh year the dose = 20 lbs. per tree is kept constant. The above formula is recommended for Santras in Madhya Pradesh.

| 9. | 1st year lbs. | 2nd year lbs. | 3rd year lbs. | 4th year lbs. | 5th year lbs. | 6th year lbs. |
|---|---|---|---|---|---|---|
| Cattle manure | 20 | 29 | 38 | 47 | 56 | 65 |
| Ammonium Sulphate | ½ | 1 | 1½ | 2 | 2½ | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ash | 1 | 2 | 3 | 4 | 5 | 6 |
| Bone meal or Super Phosphate | ½ | 1 | 1½ | 2 | 2½ | 3 |

From the seventh year onwards till the tenth year increase the quantity of cattle manure, Ammonium sulphate, as above and ash, and bone meal by ¾ pound and 1½ lb. per year. Thus a ten-year old tree will receive about 100 pounds of cattle manure, 5 pounds of ammonium sulphate; 12 pounds of ash and 6 pounds of super phosphate or bone meal.

Cattle manure should be applied at the beginning of the rainy season and the fertiliser mixture after the rains are over. Excessive application of cattle dung effects the quality of the fruit. It is therefore advisable to alternate this manure with urine earth.

10. Ammonium sulphate 10 parts. Potassium Sulphate 20 parts. Cake 30 parts. Super phosphate 40 parts. apply at the rate of 10 to 15 pounds per tree. Starting with 10 pounds for 6 year old trees and increasing the quantity by 1 pound per year.

**Time and method of Manuring:**

Manuring of citrus is an operation that requires study and intelligence. It is not advisable to follow any rule of the thumb method. The age of the trees and their condition, the state of the weather have to be given careful consideration. It has been truly said of citrus fruits that "they reflect in their character and quality the wisdom and care of him who produces them". The common belief that trees with a crop on does not require any manure especially when the fruit begins to ripen, is not true. Trees require manure during this period also, to enable them to prepare for the next crop sometimes. This will perhaps be helpful in securing uniform crops from year to year.

Young plantations are manured twice in the year once at the commencement of the rains and again after the

rains. When the trees get to bearing age, manuring is done at the time when they are treated for crop. In the Deccan, plantations are treated for fruit at any one or more of the three seasons when citrus trees flower:—June, October and February. In South India two applications are given one between June and August and another during December and January.

It is not advisable to apply nitrogenous manures with the others when the plantation is treated for fruits; for, this hinders flowering and encourages vegetative growth. Nitrogen is best applied when the fruits are set. In most parts of India it is a common practice to apply manure in a heap immediately round the trunk but during recent years some improvement has been effected. It is applied by hand in a ring or basin around the tree. The benefits of applying fertilizers where feeding roots are found in abundance is being slowly realised. The golden rule is that plant food should be evenly distributed on the ground occupied by the feeding roots. This zone, in the case of young trees, lies just within and outside the ends of the branches. The branch spread forms as it were, the centre of a circular band a few feet wide on which the manure should be spread. In a mature plantation the roots of the trees practically occupy the whole of the area and manure must be applied to the entire surface.

It appears that in Western countries this requirement is fulfilled by applying manures by what is known as the furrow method. The furrows during the first year run along both sides of the line of trees. In the following year they are made to run at right angles to those of the previous year. In the third year the furrows run as in the first year but nearer the centres of the tree rows and similarly in the fourth year the furrows are made to run parallel with those of the second year and so on.

During the early years of the plantation the growing of green manure crops and ploughing them under, greatly help in both enriching the soil as well as improving the texture of the soil.

**Inter Crops — Cover Crops — Green Manure Crops:**

The cultivation of cover crops is an important part of orchard management. During the 1st 3 or 4 years of orchard life there are enough interspaces to permit the growing of these crops. Prevention of soil erosion, removal of excess moisture, addition of organic matter to improve retentivity of soil, control of weeds, and addition of plant food by leguminous crops can be achieved by growing crops like Sunn hemp, Daincha, Beans, Cowpea, Pillipesera etc. Sometimes Vegetables are also grown and even fruit trees like Bananas, Papayas, Pine apple or Grapes are also grown to give some income to orchardists during the prebearing period of orchard.

The choice of these subsidiary crops depends upon local conditions, the situation or nature of the soil, the climatic conditions and the water supply. It is advisable to avoid crops that demand frequent and abundant watering, as excess of moisture is likely to harm the trees. Crops that are spreading and tall and likely to shade the fruit trees, or crops that are gross feeders and consequently likely to rob the orchard trees of plant food are also better avoided.

It is a common orchard practice in India to grow vegetables like guar, bhendi, tomatoes, chillies, brinjals, beans, leafy vegetables and sometimes wheat. During recent years crops like bananas, papayas and grapes are being grown especially in the hot and dry parts of the Deccan and Bombay State. These crops are however removed after the third year. In the heavy rainfall tracts of the South Coffee and pine apple plantations are frequently grown together as mixed crops.

It is obvious that all soils cannot be treated in the same way. No person can be expected to know as much about the conditions of an orchard as the man who grows it. He alone is best fitted to decide whether his orchard can be inter-cropped or not, and what crop to grow on his land under his conditions. In intercropping,

*cover cropping*, or *green manuring* of citrus orchards the following precautions should be taken.

1. *No secondary crops should be kept within atleast* four feet from the orchard trees;
2. In hot weather and dry tracts, green manure crops should be ploughed and incorporated into the soil only when it has become dry. Otherwise an acid condition hostile to the growth of such crops in the following years is developed.
3. If fertilizers are used the potash and phosphoric acid content should be made proportionate to the amount of nitrogen given by the secondary crop.

Some orchardists seem to be of the opinion that inter-cropping while it may bring some temporary income, is likely to damage permanently the trees. If, however, care is taken to maintain the soil fertility and if the orchard crop always receives the primary attention, secondary crops far from being harmful in any way, may be beneficial in many ways.

**Pruning:**

It is agreed that no fruit trees require less pruning than the citrus group once they get established in the orchard. But there is considerable difference of opinion with regard to the best method of training and pruning of the different varieties and species of citrus. Experience however shows that a certain amount of pruning is necessary. Judicious pruning results in shapely trees, that make them look attractive, in building up a frame work that will enable it to bear heavy crops when mature, and in the removal of all undesirable parts. Citrus trees may be trained to a high or low head. Some people are in favour of *having high headed* trees because they will have clean trunks up to a uniform height of three to four feet and look very attractive, and provide ample space for cultural operations to be carried out with ease, low headed trees with branches hanging down to the earth are subject to

damage by the cultivator during operation and it is difficult to keep them from injurious insects because effective spraying or dusting is not so easy. Others however, are of the decided opinion that low headed trees are better for the following reasons:—

1. The trunk is protected by the foliage from the heat of the Sun and cold;
2. The fruit is easily harvested and there is less danger of damage by high winds;
3. The ground beneath is shaded and rapid evaporation of moisture is prevented.

Whatever the choice of the type of tree that is wanted, the young plant before planting has to be pruned. The leaves and a part of the top are removed to help the young plant to establish itself in its new environment. Soon after planting, the young plant starts throwing out shoots scattered along the stem bottom to top. Those that develop below the bud joint are obviously from the stock and should therefore be removed. The other shoots rising from above the bud joint should be allowed for the time being to remain. They, while helping the young plant to establish itself, and to increase its thickness, protects the trunks from the Sun. After one or two seasons these shoots may be thinned out leaving 4 or 5 selected ones and properly distributed round the stem to form the main frame work of the head of the tree. In the ensuing early years the plants should be helped to develop a good shape. Under normal conditions citrus trees get on very well without such help for, it is their natural habit to develop shapely heads. After the frame work branches get well established, very little pruning is necessary except the removal of unusually vigorous branches called water-sprouts or suckers. Root stock suckers will keep on coming for a considerable time after planting and very frequently considerable damage has resulted by neglect to remove them in time. If these are not removed in time they grow more vigorously than the scion and smother it before the grower becomes aware

of it. It is always a good rule with citrus trees that pruning, when felt necessary, should be done towards developing the tree along natural lines. Severe pruning hampers natural growth and is likely to bring in diseased conditions. Dead wood should be as far as possible removed. Often it is not possible to remove all dead wood, especially the small twigs. It is not absolutely essential as such dead wood does not in any way affect the yield or quality of fruit. It is helpful, (if it could be done) in harvesting and renders pest control easily and in improving the general appearance of the tree. In case where the trees are affected by disease, such as 'canker', 'withertip' or 'die-back', it is better to prune away all diseased portions large or small. The presence of dead wood sometimes causes injury to the fruits. If branches are found rubbing against one another it is best to cut them out entirely.

**Prunning Neglected Trees:**

In some cases it sometimes happens that orchards are neglected or abandoned for a considerable length of time and left entirely to themselves. In such orchards if the trees are of some age and of good size, can be renovated by cautious pruning.

Trees very much damaged should be removed and replaced with new stock. The others should be carefully pruned each according to its conditions. Dead branches and those in poor conditions should be removed and if a sufficient number remains after this operation, the tree will naturally form a new head. If however the top has only very few branches left, it is better to cut each of them back leaving the main trunk and short stubs of the main branches.

The trees should be sprayed for disease and insects' attack and all injured portions properly treated. The orchard should be ploughed up thoroughly and adequately manured, treating it during the following two or three seasons as for a young plantation. All efforts should be directed towards bringing the trees back into good vigorous growth. During summer the trees should be protec-

ted from the Sun by painting them with redochre (geru) or by white washing.

In order to facilitate easy application of fungicides or insecticides in the interior of the trees some branches have to be removed. This pruning should be severe as such pruning is generally followed by a vigorous growth of fresh sprouts and the interior of the trees becomes as crowded as before.

**Wound Protection:**

When the trunk or branches are injured by pruning or some other causes and the underlying wood is exposed, the exposed surface should be protected to prevent entry of harmful germs. Small wounds less than about ½ inch do not usually need any protection especially if the tree is in a healthy condition. Larger wounds must receive proper protection. Normally wood tissue grows from the outer edges of the wound towards the centre and ultimately covers it.

White lead paint is generally used to cover such wounds. Hume recommends an asphalt benzine mixture. The asphalt is melted over the fire and allowed to cool. Then enough benzine is stirred into, to bring it to the working thinness of good paint. Though there is not much harm in pruning citrus trees at any time, it is better to avoid those periods when the trees are in active growth. Root pruning of citrus trees is undesirable. Roots are injured while the orchard is ploughed. Both the operations are injurious to the health of the plant and some times prove dangerous to its life. Root pruning results in normal growth being checked and if performed constantly leads to deterioration in the condition and a marked decline in the life of the tree.

**Cropping or Treatment of Fruit:**

Some citrus varieties flower more or less all the year round but most of them have one or more distinct flowering seasons. In the Deccan, Madhya Pradesh and Western

India the sweet oranges and other mandarins which are the most important commercial fruits, have three distinct flowering seasons. Locally they are known as the Mrig Bahar (June, July flowering), the Hasta Bahar (September, October flowering) and the Ambe Bahar or the February, March flowering. The first two take their names from the Mrig and Hasta Karties and the last is known as 'Ambe' (mango) bahar because it happens to coincide with the flowering of the mango (ambe). Left to themselves trees put forth fresh growth during each of these periods and often flower and fruit in all of them. Under cultivated conditions, with the object of getting the most from the orchard, the trees are treated in a special manner to induce them to put forth their best. While it is possible to treat trees for more than one crop, it is usually considered advantageous to make them bear only one heavy crop in a year.

Under careful cultivation budded citrus trees begin to bear from the 4th year after planting, but the knowing cultivator does not allow the flowers to set or the fruit to develop. Early cropping obviously tends to weaken the young plants. In the 5th year, though the trees are not treated for a crop, a fair percentage of the fruit that is borne without it, is allowed to mature and the harvest marketed.

Regular treatment for fruit starts in the sixth year. The choice of the actual crop to be taken is determined by the availability of labour, local market conditions and fruit pest and water supply.

**'Mrig Bahar':**

For the Mrig Bahar crop, flowering occurs during June and July and the fruits are harvested between March and May. As oranges are in great demand during these months especially the santra growers make considerable profits from the crop. As water is with held for quite a time before flowering time the question of water supply during April and May when there is scarcity of

water in irrigation wells does not seriously arise. The citrus fruits are subject to attack by the fruit sucking moth which very often causes heavy losses to the crop. The danger from this pest to the mrig bahar crop is obviated as the fruits ripen during the wet weather when this enemy is least active and because the fruits are raw and sour during the rains when the insects are most active. They do not attack raw fruits.

**'Hastha Bahar' or October flowering:**

Normally it is not possible to treat the trees for this crop as rains during the preceeding months give little chance for stopping water which is an essential feature of the treatment. Some times owing to slightly favourable conditions of weather as when there is long spell of dry weather during September the trees flower and bear a crop which is at best, of an inferior quality, and rarely remunerative. The fruit of this bahar comes into season during the rains when citrus fruits are not much in demand. In regions of poor rainfall of about 16 or 18 inches, it is often possible to take this bahar and make it pay the grower.

**'Ambe Bahar':**

This bahar flowers during February and March and comes into the market from November onwards. As there is a fair demand for the fruit during the Christmas and New Year season, Orchards are often treated for this bahar even at the risk of the crop being attacked by the fruit moth during the ripening period commencing from August when it is very active. As most orchards depend upon well irrigation, orchards treated for this crop require to be adequately watered during the ensuing hot months. There is always the danger of the crop suffering from scarcity of water during this period.

Taking all things into consideration the Mrig bahar is considered to be the most advantageous in areas that depend upon irrigation from wells, and distant markets. The difficulty of obtaining labour in May and early June is great owing to every one being engaged in preparing

for the monsoon crops. Having selected the bahar best suited to his conditions the grower should stick to it as far as possible throughout the life of the orchard. A change over to another bahar is attended with risks of low yields and poor returns. For orchards subjected to a definite seasonal treatment get used to it, and automatically respond well to such treatment. A change from one bahar to another causes dislocation of fixed arrangements and goes against the grain of habit formed by the orchard. While it is not desirable therefore, to change the bahar, it can be done if the grower has to do it owing to changed conditions. In such cases one crop has inevitably to be sacrified, before a change over to another bahar can be made. Trees treated for the mrig bahar in June cannot be treated for the bahar during the following February unless the fruit of the previous bahar is sacrified. Subjecting the plantation to two resting periods within an year, is likely to affect the plantation adversely. In spite of this fact and though the practice is not desirable some growers do take two crops in the year and this unknowingly perhaps help to shorten the life of the plantation.

**Treatment for Bahar:**

The main purpose for treating a plantation for crop is to check vegetative growth and to stimulate flower formation. The treatment consists in gradually reducing the water supply and stopping it entirely for a period of time which varies according to the local soil and climatic conditions immediately before the flowering season. For the mrig bahar, water is with held from April and for the ambe bahar from about the middle of November. The resting period or the period of starvation as it may be called is less in lighter soils than in heavy soils, which naturally being more retentive of moisture requires a longer period of rest. The plantation is ploughed up as soon as this condition of the soil allows it and the trees are cleared of all dead or dying shoots. When as a result of the stoppage of water the leaves begin signs of withering and start shedding the basins round the trees are dug up to a depth of about 9 inches and the roots are kept

exposed for about a week. Manure is applied and mixed with the dug up soil and the basins are filled up again. Some growers prune all the fibrous roots attached to the main roots immediately round the trunk and at the same time trim all the roots that get injured during the digging. This is followed by the first irrigation which in the case of mrig bahar has to be done during the last week of May and early in January for the ambe bahar. The first watering is very sparing, the trees getting only about a quarter of the quantity that they normally require, the second which follows after three or four days should be more copious and the third which is given about eight days after the first is a full quantity. Trees treated for mrig bahar must receive the first two waterings before the monsoon starts. Otherwise heavy supplies of rain water immediately after manuring causes undesirable vegetative growth to the detriment of flower bud formation. In heavy soils the trees requires longer period of rest and if even after prolonged rest the leaves still keep green, root pruning is resorted to. About a month after the first watering, the trees begin to put on fresh growth bringing the flower buds on them. When the fruits begin to set, the nitrogenous part of the manure mixture is applied to help the fruit to develop. During the flowering months; when the fruits are developing the plantation is watered at regular intervals till the fruits begin to ripen. About ten months after treatment the water is again withheld to help the fruits to become sweeter. The basins of the trees are kept free of weeds and the soil stirred up occasionally for proper aeration and to encourage sizing of the fruits.

Between the Northern parts of India and the South, there is a little difference. Flowering for the main crop of sweet organges occurs from December to April and fruits are in the market between November and March. Another flowering occurs from September to early December and the fruits are in season from June to November. In Andhra —the Batavian oranges are in season from July to December and the vadlapudis from August to January. A 3rd crop of sweet oranges the sathgudi or chini is harvested

from March to June. In normal years the sathgudis yield two crops in the year and special treatment is given for securing harvests at a particular time as is done in the Deccan, Central Provinces and Western India, Coorg Santras are in season from December to April and again between July and September. Some are in season almost throughout the year, the peak period being between May and August. At Kodur Pummeloes, and citrus are in season from August to November and the lemons from May to September (Naik).

In North India the most common period is February. No special treatment is necessary for indusing flowering in parts where there is a distinct winter (Hayes).

**Harvesting or Picking of Fruits:**

The sweet oranges and the mandarins get ready for harvest about ten months after the trees blossom. Fruits usually develop an yellow or an yellowish orange colour Harvesting is done according as far as possible, to the needs of the market. Oranges can continue to remain on the trees for quite a considerable time after they are fit for harvest. Fruit of the previous ambe bahar have a higher value than the early harvests of the mrig bahar because of their sweetness due to having been on the trees long after the ripening time.

In India the harvesting of citrus fruit is very carelessly done and deplorable indifference is shown towards the heavy losses that unnecessarily occur owing to the bad picking and bad handling of the fruits after harvest. The essential equipment of fruit picking devices, such as step ladders and soft bags to receive the harvested fruit so commonly used in the Western countries are conspicuous by their absence in our country. It is estimated that as much as 25 per cent of the harvested crop is lost between the orchard and the market. Hand picking is the rule, bending the branches and pulling the fruits is common and storing is defective.

It is time that growers give their serious attention to these small details to get the best and most out of their orchards. It is indeed a great pity that good fruits should be injured or damaged owing to indifference and neglect in picking. With careful picking with the help of fruit gatherers, ladders, and suitable bags careful handling of the fruits after harvest a great deal of loss can be avoided. The additional cost as against the gain is very small indeed. It is always advisable to harvest fruits in congenial weather conditions. Oranges should not be picked in wet weather, neither when the fruits are moist nor with dew. It is considered advantageous to pick orange fruits from the lower branches first; then from top branches to prevent rotting and to reduce affects of wind falls; and finally from the middle of the tree.

Citrus fruits unlike many other fruits, where the ripening process continues after harvesting, do not ripen after picking. They do not become any better than at the time when they were removed from the tree and do not change their acid or sugar content. It is, therefore, very necessary that citrus fruit should be picked only after full maturity. Some one who was asked as to when an orange was ripe answered "if, after eating one orange, there is a desire to eat a dozen, the fruit is ripe." Lemons and limes may be picked when green but they should be sufficiently mature before leaving the trees.

The appearance of citrus fruits gives one impression that they can stand rough handling owing to their tough rind. If handled with care they are capable of it, but if the rind is injured they get spoiled very quickly.

Fruits get injured owing to several causes while being picked; viz:—

1. The finger nails of the harvesters;
2. Rough or pointed materials in bags or baskets;
3. Bruises caused while being emptied from one container to the other or when dropped;

4. Protruding fruit stalks;
5. Accidental cuts by the fruit gatherers.

Proper colour of ripe fruit is valuable for, it helps much in citrus being sold to best advantage. Green colour of fruit suggesting immaturity lessens the chances of fetching a good price. In Western countries harvested fruits are artificially coloured to meet the requirements of the market.

**Grading:**

In foreign countries great care is taken after harvesting to remove all undesirable fruits, mishappen, bruised, insect infested and then graded according to size and often according to colour also, in order to meet the very rigorous demands of the market. In our country, however, very little is done in this way and fruits are sent over to the market in the condition in which they are received from the orchard. During recent years however, some grading has come into practice, and sweet oranges are graded into different grades according to their size. The santras owing to their irregular shape do not easily lend themselves to satisfactory size grading.

**Packing:**

Almost throughout the country harvested fruits are hauled from the field filled loose in bullock carts or in lorries to the packing shed or very often to the market direct. This results in great loss to the growers. When sent to distant market by the train, the loose skinned oranges are usually packed in bamboo baskets or sometimes in deal wood boxes. The tight skinned oranges — the mosambi, sathgudi, limes etc. are packed in gunny bags, each bag containing several dozen fruits of oranges and several hundreds of sour limes.

On the whole, the prevailing practices of picking fruits and handling them, need a great deal of improvement. If the importance of these factors are realised by

growers, much avoidable waste and lôss of money can be prevented. Money saved is money gained.

**Marketing of Fruits:**

The most prevailing practice all over the country is to sell the standing crop to a class of people known as 'bagwans'. These middle-men purchase the entire crop at flowering time or when the fruits are young and take over the management of the garden till the harvest is completed. The owner supplies the irrigation water and hauls it up at his own cost. The Contractor finds the market, sends the fruit to commission agent in the various distant markets. For the trouble taken in the disposal of the produce he sometimes makes as much out of the garden as the owner. The owners in many cases have neither the time nor the facility to do the watching or the intelligence to find the market. The commission agents also sometimes undertake to purchase the orchards on contract and sell the fruit on arrival from the plantation to the retailers or the public through private treaty or public auction.

**Yields:**

Reliable data with reference to the yields of citrus trees are almost impossible to obtain in this country. On rough estimation 300 to 400 fruits per tree in the case of oranges and 500 to 1,000 fruits for sour limes may be taken as average yields, in the poorer soils of the Telangana. In the Marathwada districts the mean yields per tree are higher. Some orange trees have been known to produce even 2,000 fruits.

According to the 'Report on the marketing of citrus fruit in India' the average yields are estimated as follows:

**South India:**

| | | |
|---|---|---|
| 1. | Batavian Oranges | 90 to 120 mds. an acre. |
| 2. | Sathgudi Oranges | 90 to 100 ,, |
| 3. | Vadlapudi Oranges | 200 ,, |

| | | | |
|---|---|---|---|
| 4. | Mandarin | 150 | ,, |
| 5. | Sour Limes | 200 to 250 | ,, |
| 6. | Pummelos | 180 to 400 | ,, |

Yields however vary greatly in the different citrus growing tracts of India. It is estimated that the average yield of the different fruits in India is as follows:—

1. Sweet oranges yield about 100 maunds per acre in Madras, Punjab and U.P., 140 maunds in Bombay and 180 maunds in Hyderabad.

2. The loose skinned oranges vary from 50 to 364 maunds, limes from 79 to 300 maunds, pummeloes from 83 to 400 maunds and sweet lemons from 100 to 152 maunds.

—*—

# ERRATA, CITRUS Vol. II.

| Page No. | Para and Line No. | For | Read |
|---|---|---|---|
| — | Contents | Prunning | Pruning |
| 2 | 3, 8 | Personnal | Personal |
| 6 | 2, 3 | accummulation | accumulation |
| 8 | Item 7, 7 | chek | check |
| 9 | 2, 2 | necessiates | necessitates |
| 10 | 4, 10 | inadequate | in adequate |
| 11 | 3, 2 | Shedding coarse | Shedding, coarse |
| 12 | 6, 3 | fruit with | fruits with |
| 19 | 6, 15 | ease, low. | ease and low |
| 20 | 5, 11 | Protects | Protect |
| 21 | 1, 10 | control easily | control easy |
| 21 | Subhead | Prunning neglected trees | Pruning Neglected trees |
| 25 | 2, 16 | shedding the basins | shedding. The basins |
| 26 | 1, 18 | trees requires | trees require |
| 27 | 1, 4 | Western India, coorg | Western India. Coorg |
| 27 | 2, 2 | indusing | inducing |
| 29 | 2, 2 | mishappen | misshapen |